



INTERNATIONAL RICE COMMISSION

NEWSLETTER

Ref 710

EXTERNAL RELATIONS
18 AUG 1960
RECEIVED

Vol. IX, No. 2

June, 1960

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FOOD AND AGRICULTURE ORGANIZATION
REGIONAL OFFICE FOR ASIA AND THE FAR EAST
BANGKOK
THAILAND





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SEED CERTIFICATION SCHEMES FOR RICE IN VARIOUS COUNTRIES¹

G. Julen² and A. Kjaer³

Introduction

At the Seventh Meeting of the Working Party on Rice Breeding held at Vercelli, Italy, in 1957, it was recommended that FAO should take steps to furnish interested countries with an outline of the essential features of several of the most satisfactory seed improvement schemes now in operation. For that purpose representatives from different countries were asked to send to FAO information on their seed production and distribution regulations. Such information has now been received from Australia, Ceylon, France, India, Japan, the Philippines, Portugal, Taiwan, Thailand, the USA, and Venezuela. In India the regulations for seed multiplication and certification are different in the various States and areas and the information obtained refers only to the State of Andhra Pradesh. In the United States of America the regulations are also somewhat different in the various States and the regulations from Louisiana and Texas are presented here. Certain other countries have sent information of a more general nature which is summarized and included in the appropriate sections. International aspects are also mentioned, where appropriate.

In order to make it easier to compare the systems used in the different countries, the seed multiplication and certification schemes are not described for each country

separately, but are discussed step by step and for each step the details for all the countries concerned are given.

Information on rice seed multiplication and certification in different countries has been published from time to time. A list of publications dealing with this subject is given at the end.

The purpose of seed certification is the same throughout the world. It is very clearly defined in the "Minimum Seed Certification Standards" published by the International Crop Improvement Association (1959):

"The purpose of Seed Certification is to maintain, and make available to the public, sources of high quality seeds and propagating materials of superior varieties so grown and distributed as to ensure genetic identity. Only those varieties that contain superior germ plasma are eligible for certification. Certified seed is high in varietal purity and of good seeding value.

"Varieties eligible for certification have resulted from natural selection or through systematic plant breeding. In either case without a planned method for maintaining genetic purity, there is grave danger of losing varietal identity.

¹ Background paper prepared for the Working Party meeting on Rice Production and Protection held at Ceylon, 14-19 December 1959.

² Plant Breeding Specialist and Seed Production Specialist, respectively, Crop Production and Improvement Branch, FAO, Rome.

"Varietal purity is the first consideration in seed certification but other factors, such as weeds, diseases, viability, mechanical purity and grading are also important. One of the most effective methods of preventing the wider distribution of weeds is to plant weed-free seed. Adverse effects of plant diseases can be reduced by planting clean seed from disease-free fields. Properly cleaned and graded seed is easier to plant and gives more uniform stands. "Seed certification is designed, therefore, to maintain not only the genetic purity of superior crop varieties, but also reasonable standards of seed condition and quality".

1. Authority to decide on the varieties to be included in the certification scheme

As only a restricted number of varieties can be dealt with in a certification scheme, the varieties must be tested and the best approved for further multiplication. This approval must be carried out by a specific authority. It is done in somewhat different ways in the various countries.

France: According to a special decree, only rice seed, whether imported or locally produced, of varieties entered into the official catalogue may be marketed.

India: In the State of Andhra Pradesh the paddy specialists recommend the tested varieties to the extension staff. The final decision on the varieties which should be multiplied in different areas and on the multiplication program in the different districts is taken at annual

meetings held by the Deputy Director of Agriculture.

Japan: The Ministry of Agriculture and Forestry declare the improved varieties as new varieties after they have passed specific and adaptability tests. Each Prefecture decides after testing which of these varieties shall be multiplied in the Prefecture after having conferred with the Selection Committee for Selected Recommended Varieties.

Malaya: The choice of varieties for the different areas is made after consultation between the rice specialists, the State agricultural officers and the Assistant Director of Agriculture. The basis is the results of trials, the preference of farmers and millers, the quality, and the adaptability over a large region.

Philippines: Those varieties resistant to root rot which have given the best results in regional trials for three years are recommended for multiplication by the Recommending Committee composed of two members each from the College of Agriculture, Bureau of Plant Industry (BPI) and the Bureau of Agricultural Extension (BAE). The Recommendations are approved by the Approving Committee composed of the Directors of BPI and BAE and the Dean of the U.P. College of Agriculture.

Portugal: Decision on varieties to be included in the certification scheme is made by the General Directorate of Agricultural Services in consultation with the Commission for Regulation of Trade in Rice.

Taiwan: The Department of Agriculture has established a Rice Improvement Conference (RIC) which meets

twice a year, once for each rice crop, and is attended by the rice breeders and the senior extension officers of all Prefectures. Based on advanced tests, regional tests, demonstration plots, and opinions of the farmers, a decision is made on varieties to be eligible for certification during the next crop season. On this basis the Department then makes a final list which is to be followed by the certifying agencies.

Thailand: The authority to decide on varieties to be included in the certification scheme is vested in a Committee with the following composition: Under-Secretary of State of the Ministry of Agriculture (Chairman), staff members of the Rice Department, representatives of the Ministries of the Interior, Economic Affairs, and the Department of Agriculture, five representatives of rice millers' associations and rice trade agents, and four farmers.

USA: In *Louisiana* new varieties are tested and approved by the Louisiana Experiment Station and/or an approved rice breeder. In *Texas* the new varieties are approved by the Experiment Station.

2. Number of recommended varieties

The number of varieties recommended in different countries varies tremendously. It is desirable that these numbers should be as low as possible but on the other hand there must be varieties enough to meet all the different requirements in the various parts of the country.

France: In *Metropolitan France* nine varieties are at present in the catalogue. In *Madagascar* ten varieties are multi-

plied by the six multiplication centres in the various provinces. In *Senegal* eleven varieties are multiplied by two centres; in *French Sudan* thirteen varieties at two centres, two of the varieties being floating rice; and in *Tchad* four varieties are multiplied at one centre.

India: In the State of Andhra Pradesh 60 varieties have been approved for the Andhra area, but only 25 to 30 are cultivated on a large scale. In the Telangana area 18 varieties have been approved, out of which only 12 are grown on a large scale.

Japan: Over the whole country 360 varieties are involved, but only 41 varieties are grown on a large scale.

Malaya: The number of recommended varieties is 35 for the whole country, but the actual number of varieties grown is higher.

Pakistan: 62 varieties are recommended for East Pakistan, and 27 for West Pakistan.

Philippines: For the two groups, lowland and upland rice, seven varieties are recommended for each.

Portugal: The number of recommended varieties is nine.

Taiwan: 20 varieties are recommended.

Thailand: For the central, north and north-east of the country, 11 varieties are recommended. More varieties will be added to the list, but the total number will not be more than 25 to 30 varieties for the whole country.

USA: In each of the two States of *Louisiana* and *Texas*, seven varieties are recommended. Apart from these two States, rice is also widely grown in the

States of Arkansas, Mississippi and California, and to a more limited extent in Florida, Missouri, Oklahoma, South Carolina and Tennessee. The number of varieties grown varies from 3 to 8 in these States.

Venezuela: Only varieties resistant to the "hoja blanca" disease are recommended. There are at present eight varieties on the list.

3. Certification classes

The multiplication has to start with a limited amount of seed produced by the plant breeders and has to be carried out through a number of generations. The generations are for certification purposes grouped in different classes.

In order to facilitate seed exchange and trade it would be valuable if countries having a similar seed certification scheme used the same name for equivalent classes of seed. The problem was discussed and a proposed system adopted by the Far East Seed Improvement Conference held in Taiwan in 1956. The Conference recommended the following two systems:

System 1

Breeders Seed

Foundation Seed

Registered Seed

Certified Seed

System 2

Breeders Seed

Foundation Seed

Stock Seed

Extension Seed

It was suggested that System 1 be used when all four categories were covered by both field and laboratory inspection, but if the two latter categories were covered by field inspection only, System 2 should be used. The number of classes and the names for them are, however, still different in the various countries.

Australia: Stud Seed
Foundation Seed
Pure Seed

Ceylon: Foundation Seed
Primary Seed
Secondary Seed

France: Seed for Reproduction
Seed without special denomination

India: Foundation Seed
(State of Andhra Pradesh) Nucleus Seed
"A" Class Seed
"B" Class Seed
"C" Class Seed

Japan: Breeders Seed
Elite Seed
Basic Seed
Certified Seed

Malaya: Foundation Seed
Progeny Seed
Multiplication Seed
Seed from Seed Farms

Philippines: Breeders Seed
Foundation Seed
Registered Seed
Certified Seed, 1st and 2nd generation

Portugal: Certifield Seed

Taiwan: Breeders Seed
Foundation Seed
Stock Seed (Registered Seed)
Extension Seed (Certified Seed)

Thailand: Breeders Seed
Foundation Seed
Stock Seed
Multiplication Seed

USA: Foundation Seed
Registered Seed
Certified Seed

Venezuela: Foundation Seed
Registered Seed
Certified Seed

4. Authority responsible for production of the different classes

In order to secure the production of a sufficient amount of seed in the different classes many countries have arranged for special authorities to be responsible for the production of certified seed.

Australia: This country has a pure seed scheme for all major varieties. After purification, which takes four years and results in stud seed, this is sown to produce foundation seed which is distributed by the Rice Marketing Board to seed growers selected by a special Pure Seed Committee. Seed harvested from these fields is distributed to farmers as pure seed.

Ceylon: Foundation seed is produced by the breeder. This seed is handed over to the Production Officers of the Department of Agriculture who are responsible for the production of primary seed. This seed is produced in the Department's primary seed fields and handed over to the District Extension Officers who are responsible for the production of the secondary seed. This seed is produced by registered seed growers on private seed farms selected by the Extension Officers.

India: In the entire State of Andhra Pradesh, the foundation seed is produced at the agricultural research stations. It is then passed on to State seed farms for multiplication. The nucleus seed produced is then grown by selected progressive farmers called A, B, and C seed class farmers.

Japan: The Ministry of Agriculture and Forestry is responsible for the production of breeders seed and the different Prefectural Governments for the production of elite seed, basic seed and selected seed.

Malaya: Foundation seed and progeny seed are maintained by the plant breeders. Progeny seed is passed on to the State Agricultural Officers, who multiply it for direct distribution to farmers or to selected growers for the production of seed from seed farms. The seed farms are under direct supervision of State Officers and all seed thus produced is sold back to the Department, which in turn distributes it to farmers on an exchange basis.

Philippines: Breeders seed and foundation seed are produced by the College of Agriculture and the Bureau of Plant Industry. The Bureau and a few selected growers produce registered seed, while first and second generation certified seed are produced by selected growers appointed by the Bureau of Plant Industry and the Bureau of Agricultural Extension.

Portugal: The General Directorate of Agricultural Services is responsible for the production of certified seed.

Taiwan: The breeding stations produce breeders seed which, on foundation seed farms, produces foundation seed. This seed is used on the stock seed farms to produce stock seed, which in turn is handed over, by the Prefectural Governments, to the extension seed farms where extension seed is produced. This seed is then distributed to farmers on a bag-for-bag basis, or at a premium of not more than 20 per cent.

Thailand: The Rice Department is responsible for the production of breeders seed and foundation seed. The stock seed and multiplication seed are produced by selected seed growers.

USA: In *Louisiana* and *Texas* foundation seed is grown under the supervision of the experimental station or an approved plant breeder. No special authority is responsible for the multiplication of the later stages but any approved "Certified Seed Grower" who wants to have his crop certified must apply for inspection from the certifying agency.

5. Type of inspection

In all of these countries both field inspection and laboratory tests are required for certification. In Ceylon, India and Japan field inspection must be carried out at least twice during the vegetative period, once before flowering and once at the milk or dough stage. In the USA only one field inspection is required.

6. Inspecting authority

Ceylon: Field inspection is carried out by the District Extension Officer and the seed control by plant breeders.

India: In the *Andhra* area the field inspection is conducted by the agricultural administrators and the seed development assistants in the different districts; in the *Telangana* area by the paddy seed multiplication officers.

Japan: The Prefectural Governments appoint special inspectors.

Malaya: The seed farms are inspected by State officers.

Philippines: The inspectors of the Bureau of Plant Industry (BPI) are responsible for the field inspection of

registered seed. The certified seed is controlled by these inspectors and the seed supervisors of the Bureau of Agricultural Extension. Seed control is conducted in the seed certification laboratory of BPI.

Portugal: Field inspection is carried out by specially trained officers of the General Directorate of Agricultural Services.

Taiwan: Foundation seed farms are inspected by inspectors from Taiwan Agricultural Research Institute, the stock seed farms by inspectors from District Agricultural Improvement Stations and Prefectural Governments, and the extension seed farms by inspectors from the Township Office.

Thailand: Inspectors from the Rice Department have authority for inspection of classes of seed, but concentrate mainly on breeders seed and foundation seed. District Rice Agents inspect stock seed and multiplication seed assisted by local inspectors appointed by the Village Seed Committees.

USA: In *Louisiana* the field inspection is carried out by inspectors appointed by the Department of Agriculture and the seed tests are conducted in the State seed laboratory. In *Texas* the Commissioner of Agriculture is responsible for the field inspection. Seed tests are carried out at the seed laboratory of the Texas Department of Agriculture.

7. Field standards

a. General requirements

In the USA there are certain requirements on the field itself. Thus in *Louisiana* rice grown for foundation, registered or certified seed must not be

on land sown to rice the previous year or on land on which volunteer rice matured the previous year, except if grown on land which was planted to the same variety, and then only for two successive years provided the rice is of the same variety. The field must be separated from other rice fields by a fence, ditch, bare levee, road or uncropped ground at least 10 feet from adjoining drilled or dropped fields, or 30 feet where either of the adjoining fields are seeded by plane or rotary seeder. In *Texas* no variety of rice should have been grown on the same field for the previous 2-year period except fields planted in the same variety during this period and inspected and approved under the seed certification scheme. Furthermore, the fields must be clearly separated from adjoining fields by a border levee, roadway or drainage ditch. The distance between such fields must be at least 20 feet if the adjoining field is sown with a drill. If sown with a broadcast seeder the distance must be 50 feet, and if sown by aeroplane parallel to side of registered or certified seed the distance must be at least 100 feet. If sown by aeroplane at right angles to side of field the distance must be at least a 1/4 mile.

In *Venezuela* all fields for production of certified seed must be clearly separated from other rice fields by ditches, hedges, roads, etc. This distance

Philippines:

Factor	Maximum permitted plants per 100 sq. m		
	Registered	1st generation certified	2nd generation certified
Other varieties	2	4	6
Red rice	1	1	2

isolation depends on the method of sowing, and it is 10, 20 and 40 metres for drilling, broadcasting and aeroplane sowing respectively. In cases where it is not possible to keep these distances, the field for certification must be harvested either before or after other rice fields in the vicinity.

In the other countries there are no such regulations concerning the field conditions.

b. Specific requirements

Ceylon: No admixture of foreign varieties is allowed. As regards pests and diseases, any hill which is infected by diseases or pests has to be discarded. If the infection exceeds 20 per cent the whole field is rejected. The general allowable rate of infection is 3 per cent. When leaves and stems are infected slightly but there is no disease in the panicles, the seed is passed but should be issued after disinfection. Growth of plants must be uniform and healthy.

India: In the *Andhra Pradesh* area there seems to be no specified minimum requirements, but all mixtures of other varieties and off-types must be thoroughly removed.

Japan: No specified minimum requirements, but the purity and degree of disease have to be judged by the inspector.

Taiwan:

Factor	Maximum permitted		
	Foundation	Stock	Extension
Other varieties	None	None	None
Barnyard grass	None	None	None
Objectionable weeds	None	None	10 plants per 1000 sq. m.
Diseases affecting quality of seed or transmissible through seed	None	None	None

Thailand:

Factor	Maximum permitted		
	Foundation	Stock	Multiplication
Other varieties and off-type plants	None	1 per 1000 plants	1 per 500 plants
Red rice	None	None	1 per 1000 plants
Seed-borne diseases	None	None	None

USA: Louisiana

Factor	Foundation	Registered	Certified
Other varieties: plants per acre	5	10	25
Harmful diseases	trace	trace	trace
Noxious weeds:			
Red rice (including Black Hull rice) : plants per acre	2	10	25
Other weeds:			
Curly indigo, spearhead and any weeds producing insepa- rable seed: plants per acre	2	5	10
Other weeds (not named above)	Not in excess of good cultural practice		

Texas

Factor	Foundation	Registered	Certified
Curly indigo and other weeds producing inseparable seeds	None	None	None
Red rice	None	None	None
Varietal mixture, similar grain type: heads per sq. rod	None	1	2
Plants of a distinctly different grain type: heads per 5 sq. rod	None	1	1
Diseases transmissible through the agency of planting seed	None	None	None
(160 sq. rod = 1 acre)			

Venezuela:

Factor	Maximum permitted Number of panicles per 200 sq. metres		
	Foundation	Registered	Certified
Other varieties similar in grain, shape, etc.	0.5	1	4
Other varieties different in grain shape, etc.	None	0.5	2
Plants showing seed-borne diseases	None	1	2
Obnoxious weeds	None	0.5	1
Red rice	0.5	2	4
Other weeds	Preferably none		

8. Sampling

After the rice is threshed, dried and cleaned, samples must be taken and sent to the seed control laboratory. If the seed lot is small, one sample might be enough but if it is a very big lot the variation in the lot can be large and several samples might be necessary. In any case it is essential that the sample or samples really are representative of the lot.

Ceylon: Sampling is carried out personally by the Extension Officer. Separate samples are taken from each private seed farmer's stock of seed. If there are less than 5 bags a sample of 2 ounces is taken from each bag and mixed. Where there are more than 5 but less than 25 bags, samples of 2 ounces are drawn at random from 2 bags out of every 5 bags and mixed. When there are more than 25 bags they are arranged

in groups of 25 bags each and a sample is taken from each group as above. Immediately after sampling, each bag is sealed. This sealing does not necessarily mean that the seed will be purchased. The main object of it is to prevent the contents of the bags being tampered with from the time of sampling until the results of the tests are known.

Japan: Seed samples of 1 per cent of the total weight of seeds are extracted at random from 3 parts (both ends and central part) of a bag and inspected according to the inspection standards. (Information given does not make it clear whether every bag is sampled in this way or only a certain number of bags in each lot).

Philippines: Sampling is conducted by the seed inspector. A representative sample of not less than 1 kg. is taken from each lot. If one lot contains less than 10 bags, one portion is taken from each bag and mixed. If there are more than 10 and less than 100 bags samples are taken and mixed from at least 10 bags, and if there are more than 100 bags samples are taken from 10 per cent of the bags taken at random.

Portugal: During threshing operations, an information analysis is made to establish whether the seed meets the prescribed standards, and if so the seed is sacked and the bags labelled and sealed. Later, the inspector samples the bags and the samples are sent to the State Seed Testing Station for a preliminary analysis. If the seed meets the standards it is purchased immediately by the Rice Milling Committee on behalf of the Commission for Regulation of Trade in Rice. If the seed does not

meet the standards, the seals are removed from the bags, and it can then only be sold for consumption. The approved seed is passed to a Centre where the Commission, under the supervision of the General Directorate of Agricultural Services, cleans and grades the seed. Each cleaned seed lot is then sampled and the samples sent to the State Seed Testing Station for informative analysis. When the cleaning and grading is finished, suitable final seed lots are made on the basis of the informative analysis, and these lots are then sampled for final analysis. The bags are sealed and labelled with information based on the final analysis.

Taiwan: Of foundation seed samples (2 kilograms) are taken by inspectors from the Taiwan Agricultural Research Institute, and of stock seed samples are taken by inspectors from the District Agricultural Improvement Stations.

Thailand: Sampling is conducted by inspectors of the Rice Department in cooperation with District Rice Agents and local inspectors appointed by the Village Seed Committees. A central seed laboratory tests the samples of foundation seed, whereas samples of the other classes of seed are tested by the regional rice experiment stations.

USA: *Louisiana:* Samples for germination, purity and density tests must be taken from each lot or bin of seed at the time of storage inspection by an authorized representative of the certifying agency and submitted to the State seed laboratory. *Texas:* Representative samples consisting of at least two pounds should be submitted for tests to the seed

laboratory of the Texas Department of Agriculture. If the lot consists of 5 bags or less each bag must be sampled; if more than 5 bags at least every fifth bag but not less than 5 bags must be sampled. Samples must be drawn from unopened bags except under circumstances where the identity of the seed has been preserved.

9. Seed standards

The seed samples are sent for seed testing; purity and germination power or viability are the most important characters to be investigated but in many countries a much more detailed control is carried out. The requirements are generally different for the various classes of seed. In the different countries they are:

Ceylon:

	<u>Primary</u>	<u>Secondary</u>
Bushel weight, lb	45	45
Viability, %	90	85
Purity, %	99	97
Moisture	12	12
Perfect grains	95	95

France:

	<u>All Classes</u>	
Pure seed, %	98	
Germination, %	80	
Moisture content, %	15	
	<u>Seed for multiplication</u>	<u>Ordinary seed</u>
Varietal purity, %	99	96
Red rice, %	0.5	1

(Madagascar):

	<u>Most varieties</u>	<u>Other varieties</u>
Varietal purity, %	99	98
Germination	practically always above 90	

India: (State of Andhra Pradesh)

	<u>Foundation Nucleus</u>	<u>A</u>	<u>B</u>	<u>C</u>
Purity, %	100	98	92	87
Viability, %	100	95	90	87

Japan:

	<u>All Classes</u>
Germination, %	90
Perfect grains, %	90
Foreign variety	0
Foreign material	0
Injured kernels	Few or none
Colour and lustre	Proper

Volume weight, moisture content and standard quality are determined by each Prefecture.

Philippines:

	<u>Foundation</u>	<u>Registered</u>	<u>Certified</u>	
			<u>1st gen.</u>	<u>2nd gen.</u>
Pure seed, %	98	98	97	95
Germination, %	80	80	80	80
Red rice, grains/500 grains	0	1	2	3
Other varieties, grains/500 grains	0	5	8	12
Weed and other crop seed, %	0	0.05	0.1	0.2
Inert matter, %	2	2	3	5
Moisture, %	14	14	14	14

Portugal:

	<u>Certified</u>
Inert matter, including damaged kernels, %	6
Red rice, %	0.2
Other varieties	0.5
Pure live seed	$\frac{(\text{purity} \times \text{germination})}{100} \%$
	84.15
Moisture content, %	14

Note: These standards pertain to preliminary and *final tests*, except that in the final tests the maximum for *inert matter* is only 2%.

Taiwan:

	<u>Foundation</u>	<u>Stock</u>	<u>Extension</u>
Pure seed, %	99.8	99.5	99
Inert matter, %	0.2	0.5	1
Other varieties	None	None	25 seeds per kilo
Barnyard grass	None	None	5 seeds per kilo
Other weeds	None	None	2 seeds per kilo
Germination, %, first crop	90	90	90
Germination, %, second crop	85	85	85
Germination, %, intermediate crop	—	80	80
Moisture content, %	13	13	13

Thailand:

	<u>Foundation</u>	<u>Stock</u>	<u>Multiplication</u>
Pure seed, %	98	98	98
Red rice	None	None	1 seed per kilo
Other varieties	1 seed in 1000 grams	1 seed in 500 grams	1 seed in 250 grams
Inert matter, %	2	2	2
Germination, %	80	80	80
Moisture content	14	14	14

USA: Louisiana:

	<u>Foundation</u>	<u>Registered</u>	<u>Certified</u>
Germination, %	80	80	80
Pure seed, %	98	98	98
Inert matter, %	2	2	2
Other varieties (seed per pound)	1	2	3
Noxious weeds:			
Red rice (including Black Hull rice) (seed per two pounds)	1	1	2
Other weeds:			
Curly indigo (seed per pound)	1	1	2
Mexican weed	1	1	2
Spearhead	None	None	None
Other weeds (not named above) (seed per pound)	5	10	15
Note: Off-type hull colour grains occurring in any varieties, if of a similar size, quality and maturity, will be limited to (grains per pound)	10	25	45

Texas:

Pure seed, %	98	98	98
Curly indigo and other inseparable weed seeds	None	None	None
Red rice	None	1 per 10 lbs	1 per 5 lbs
Aggregate weeds, noxious weeds, and other crop seed	None	2 per lb	3 per lb
Other varieties of different hull colour	None	10 per lb	20 per lb
Other varieties of distinctly different grain size and shape	None	1 per 5 lbs	3 per 5 lbs
Inert matter, %	01.00	01.00	02.00
Germination, %	85	85	80

Venezuela:

Purity, %	
Inert matter, %	
Other varieties, seeds per kilo	
Red rice, seeds per kilo	
Weed seeds per kilo	
Diseased seeds per kilo	
Germination, %	
Moisture content, %	

<u>Foundation</u>	<u>Registered</u>	<u>Certified</u>
98	98	98
2	2	2
1	3	5
1	2	4
2	2	5
30	40	60
80	80	80
14	14	14

10. Sealing and tagging

To make sure that seed offered for sale as certified seed really is the seed that has been inspected and tested, the bags are in many countries sealed. Often a tag giving particulars concerning the seed and results of the seed test is also attached to the bag.

Ceylon: All seed that reaches the prescribed standard under the seed control is certified and printed tags are attached to the sealed bags giving information on selection number, purity, viability, date of test, grower's name, village and signature of Extension Officer.

France: All bags of rice seed must carry a label giving the following information, without any abbreviations: Name and address of vendor, name of species and variety, varietal purity and provenance of the seed.

India: In the *Andhra* area the seed development assistants collect samples once immediately after harvest, and once before distribution. The bags are stencilled and labelled for the different varieties.

Japan: If the rice seed after seed field inspection or a crop inspection is deemed to come up to the standards, a Prefecture must deliver to the applicant

a seed field inspection certificate or a crop inspection certificate provided for by a Ministerial Order.

Philippines: The inspector is required to do the tagging and sealing of the bags himself to be sure that the bags being tagged contain the original genuine seed which has passed the certification tests. Sealing is carried out properly to protect the contents of the bag and prevent the unauthorized re-use of the tag. If the seal is broken or the tag missing, the seed is not saleable as certified seed.

Portugal: All certified seed carries an official label showing the name of the producer, the variety and the results of the final laboratory test.

Taiwan: If samples are found to meet the requirements, labels are issued to the respective farm (white for foundation and purple for stock seed). For the extension seed no labels are issued, but a notice is put up at some public place in the town with information on the quality of the seed.

Thailand: Only foundation seed is bagged and labelled. Stock seed and multiplication seed are handled by local methods. Steps are, however, being taken to bag the stock seed in the near future.

USA: Louisiana: After sampling each bag must be closed by the use of a lead seal or mechanical sealer before being offered for sale, and the tag of the certifying agency must be attached to the bag with the seal with which the bag is closed. **Texas:** All bags containing registered or certified seed must be sealed in such a manner that the seal must be broken when the bag is opened. Registered or certified tags must be affixed to each bag in such a way that they cannot be removed and re-attached. All registration and/or certification tags must be issued by the Commissioner of Agriculture for labelling registered and certified seed and must bear the State seal and facsimile of the signature of the Commissioner of Agriculture and the Chief of the Division of Field Seed Certification, and be printed as follows:

Foundation tags on a background of purple with overprint of the word "Foundation"

Registered tags on a background of purple

Certified tags on a background of blue.

11. Storage of certified seed

Ceylon: Rice is stored in gunny bags supplied by the Department of Agriculture and all certified seed is handed over to the Cooperative Agricultural Production and Sales Association of the village.

India: In the State of Andhra Pradesh the Government has constructed godowns on all State seed farms. These buildings are permanent structures, well protected from rodents, termites and other pests. It is expected that by the

end of 1960 the number of State seed farms and seed stores will be 447.

Japan: Seed for sowing purposes is stored in the warehouses of the Agricultural Association under good management.

Philippines: When the seed is tagged and sealed by the inspectors of the Bureau of Plant Industry, it is purchased by the Agricultural Credit and Cooperative Financing Administration at a subsidized price. The seed is stored in well-ventilated and rodent-proof warehouses of the Cooperatives located all over the country, and sold to farmers.

USA: In *Louisiana* such inspections as are necessary in the judgement of the official certifying agency are made to determine that seed rice entered for foundation, registered or certified seed has been cut and threshed, or combined and dried, recleaned, and handled in such a manner as to prevent varietal mixture or mixture with seed not eligible for certification; and that the seed has been stored in a dry, well-ventilated, weather-proof building in such a manner as to prevent heating and mixture with other varieties of seed not eligible for certification. In *Texas* seed rice subject to approval for registration or certification must not be stored in bulk after processing. In the event of an excessive moisture being evident, it is recommended that the seed be dried in the sack. The bulk grain-dryer may be used for this purpose provided that special provisions are made to prevent mixtures. All registered or certified seed must be sacked in new, clean, even weight bags.

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REVIEW OF INVESTIGATIONS INTO PHYSIOLOGICAL DISEASES OF RICE - II

J. Takahashi¹

This paper is presented as an appendix to the article on "Review of Investigations into Physiological Diseases of Rice - I" published in the previous issue of the IRC Newsletter. A brief description of symptoms, soil and weather

conditions, time of appearance of the disease, varietal relations, possible losses and remedial measures for the various diseases as reported from the several countries is given below for reference.

Diseases reported from different countries

BURMA

Amiyit-po

Affected plant turns dark green in colour about a month after transplanting and subsequent growth is retarded. The lowest leaves tend to drop off. The plant produces normal number of tillers but many panicles remain sterile. The time of ripening is slightly delayed and the yield is very poor.

The disease appears on low-lying patches in the field and the symptoms have been reproduced in pot experiments using unrotten cow dung. The disease is not widespread in occurrence and application of superphosphate has been found to be somewhat beneficial.

Myit-po

The diseased condition becomes evident soon after transplanting. In mild cases, the affected plant grows in height

to a limited extent, produces a few sickly leaves and finally a panicle which yields only a few grains. In extreme cases no apparent growth takes place after transplanting and the plant gradually withers away within a month. Tillers are not formed in the affected plants. Application of phosphates prior to transplanting prevents the appearance of the disease and application after transplanting may act as a remedy.

Yellow leaf

Plants affected by this disease turn yellow in about a month after transplanting and remain stunted. The disease occurs in patches and tends to recur in the same areas year after year. Application of fertilizers containing SO_4 radical to water at the base of affected plants revives them to normal condition.

CEYLON

Bronzing (Browning)

The symptoms appear about two months after planting in the flooded

soil. The most obvious of these is the discolouration of the older leaves, which starts at the tip and spreads along the leaf

¹ National Institute of Agricultural Sciences, Japan.

margin, leaving the mid-rib region green. The tints on the affected leaves vary with the variety but are usually purplish or orange. Brown spots are also seen on the upper halves of the laminae of the older leaves. As the disease progresses the affected leaves dry up giving the plant a scorched appearance. In severe cases growth is markedly retarded. More commonly, growth is not seriously affected but the final yield is low owing to the presence of a high proportion of sterile spikelets. The root system of diseased plants is scanty, coarse, and dark brown. The incidence of the disease is higher during the yala (S.W. monsoon) than in maha (N.E. monsoon).

Symptoms vary with the varieties and four distinct types of symptoms could be recognized under the same soil conditions.

- 1) An orange yellow colouration beginning at the tips of the second and third leaves which spreads evenly down the leaf towards the base as the leaves mature. Varieties: Sulai 301 and Vellai perunel.
- 2) The colour of leaves initially turns deep bluish green and is followed by the formation of rusty brown patches commencing at the apex and gradually spreading down the leaf. The lower leaves usually develop the patches. The extremities of the leaves show a pale yellow colouration. Varieties: M 104 and M 303.
- 3) The plant is normal green colour initially but subsequently a pallor appears in the leaves commencing from the apex downward. When the affected leaf is examined, the lower half appears

normal green while the upper half appears pale green. Variety: SR 26 B.

- 4) The colour of the plant changes initially to a deep bluish green colour and is followed by the appearance of a pale yellow colouration along the margin of the leaf beginning from the apex. The discoloured margins die prematurely. Variety: Sinnanayan 2208.

Symptoms usually do not appear before the tillering stage. They can appear even after heading. The time of appearance of symptoms appears to be related to the degree of reduction of the soil and weather conditions.

Local farmers' varieties of ultra-wet zone of Ceylon are more resistant than hybrids and exotic varieties. Approximately 40,000 hectares in S.W. part (ultra-wet zone) are affected by this disease. Reports of the disease are more frequent during S.W. monsoon than in N.E. monsoon season.

The cause of this disease is possibly related to the high concentration of reduced products, chiefly ferrous iron. The root systems are coarse and dark brown suggesting heavy deposition of ferric hydroxide. The root system appears to be impaired which probably accounts for responses to K and P reported sometimes.

There are cases of undoubtedly spontaneous recovery probably due to improvement of weather conditions. In pot cultures, drainage, addition of nitrate and lime have checked the appearance of the disease. Under field conditions, liming to a pH of 6-6.5 has prevented the appearance of disease symptoms and yield increases by as much as 1,000 kg/ha. have been obtained.

INDONESIA

Mentek

Frequent crop failures in Java due to this disease occur in areas which are known to be responsive to P_2O_5 fertilizers, and the extent of such area is about 1/3 of rice area in Java. The disease occurs at tillering stage. Bad drainage conditions and soils with fine structure and montmorillonite as the dominant clay mineral, high content of decomposable organic matter, low in available or in total PK plant nutrients and total iron content - all there are favourable conditions for the disease. The soil types

where the disease is found are alluvial, grey hydro-morphic soils, grumosols.

Disease affects paddy every year. The incidence of the disease is variable from nil to heavy. There is a correlation between disease incidence and weather. An early onset of the wet season is associated with heavy attack. Lack of sunshine during the tillering stage stimulates mentek symptoms.

Ammonium sulphate stimulates the disease. Double superphosphate increases the resistance. Potassium sulphate in one location increased the resistance.

JAPAN

Akagare

Reddish brown spots appear on the lower leaves. These spots increase in number and at the same time other leaves are also involved. The growth of the plant is retarded in extreme cases. In mild cases, however, plants recover near heading stage and new leaves come out. But the reddish brown spots once formed never disappear and affected leaves die sooner or later. In some cases, leaf sheath turns yellow, interveinal portion becoming white and veinal portion remaining green. At this stage symptoms somewhat resemble those of iron deficiency. But soon after the reddish brown spots appear in the lower leaves and the disease progresses in the same sequence as mentioned earlier. The disease appears during tillering stage.

Upland rice varieties are generally more susceptible than the lowland varieties. Rice varieties, resistant both to the root rot and helminthosporium leaf spot,

are less susceptible to akagare. Resistance of the varieties to these three diseases has a close relationship with the resistance to the reductive condition of the soil.

The disease is not related to organic matter content in the soil or pH. It occurs on sandy soils, carbon content of which is about one per cent, whilst on the other hand it occurs on peat or muck, and on heavy clayey soils as well. The common features connected with the disease are high water table, low redox potential and greater amount of decomposable organic matter in the soil. The decomposable organic matter could be estimated from the *soil drying effect* or *temperature raising effect*. (These two terms are used in Japan to measure that portion of organic nitrogen of the soil which is converted into ammonia on air-drying the soil or raising the soil temperature).

In other word the possible causes for this disease are reduced conditions of the soil developed under stagnant water and the existence of considerable amount of decomposable organic matter. These result in retarded functioning of the roots leading to insufficient absorption of K, though usually potash itself is not deficient in the soil.

A spell of rainy or cloudy cold weather after transplantation, "soft, weak seedlings" with excessive nitrogen content and abrupt change to fine weather would appear to be favourable conditions for the disease.

As a basic remedial measure large-scale of drainage works are necessary. Where this is not possible, the following improvements in the methods of irrigation and cultivation are more or less effective:— 1) too much puddling before transplantation should be avoided, as far as possible, so as not to bring the soil to a very fine puddle. If the soil is thoroughly puddled, soil Eh goes down very quickly, 2) draining water for several days as soon as the plants are established after transplantation, 3) if the above is not possible, the field should be irrigated with running water to bring down the temperature, 4) if possible, ridges should be made all over the field during off-season and other crops cultivated on the ridges. Rice seedlings can also be transplanted on the ridges, 5) suspension of the application of organic manure, 6) incorporation of iron-rich hill soil, 7) suspension of the use of sulphate fertilizers and 8) application of potash. Except for 7) and 8) all the measures are intended to retard the development of high reductive conditions.

Akiochi (Autumn Decline)

The disease appears only during later stages of growth. In the earlier stages, the plants are normal and just before or after heading, the leaves start dying one by one, beginning with the lower ones and the shoots and panicles appear dirty. The affected plants are distinguished by the following characteristics:— 1) in spite of the large number of total tillers per plant, the number of panicles per plant is relatively small, 2) culms and panicles are short in length. Upper internodes and upper leaves are short too, 3) the total number of spikelets in a panicle is small, and sterile spikelets are relatively more, 4) paddy to straw ratio by weight is small, 5) paddy grains look dirty having dark brown spots on its surface, 6) the weight of grains per thousand is small and the quality of grain is bad, 7) lower leaves of stem die off earlier, 8) roots look pale white or black and are in contrast to the reddish brown root of the unaffected plant and 9) symptoms of *helminthosporium* disease appear. *Helminthosporium* leaf spots occur wherever akiochi is present. Therefore, the occurrence of *helminthosporium* is always considered as an indicator for the existence of the growing features akin to akiochi, as well as an indicator to distinguish akiochi field from an ordinary one. Other diseases such as rice blast and stem rot also often occur.

Akiochi is a serious problem in Japan as nearly 600,000 hectares of rice land are affected every year. The disease was formerly considered due to lack of iron and manganese. But, later investigation revealed that other substances such as silica and magnesium are also deficient. The name "degraded paddy

fields" originally applied to soils where akiuchi occurred, appears to be correct.

The possible direct cause of the disease is due to the toxicity of free H_2S evolved under reductive conditions of the soil. Hence, the application of fertilizers with SO_4 radical is not recommended for the degraded soils. The remedial measures suggested for the prevention of the occurrence of the disease are 1) suspension of the use of sulphate containing fertilizers, 2) incorporation of iron-rich hill soil, 3) application of furnace slag, which contains weak acid soluble silicate, calcium, magnesium and manganese, 4) adoption of resistant varieties and 5) draining in mid-summer, to restore the oxidative conditions of the soil.

Aodachi (Green Standing)

The leaves and stems are dark green and, at the same time, stiff. In extreme cases, the whole plant is dwarfed, having abnormally numerous leaves and small branches sprouting from the upper nodes of the stem. Sometimes there is an abnormal elongation of the internode below the surface of the soil. The abnormalities, however, are generally more noticeable in the reproductive organs than in the vegetative organs, as 1) a stem without panicle, but often with the boot leaf, 2) thin development of branches and flowers in a panicle, dwarfed development of branches of a panicle, partial fusion of branches with a main axis in a panicle and awn-like development of branches of a panicle, 3) deformity of flowers such as gigantic flowers, multiplication or degeneration of lemma, palea and glumes, 4) deformity and degeneration of stamens and pistil, 5) sterility of

flowers and 6) seeds without embryo, degeneration and imperfect development of embryo, and abnormalities in number and position of embryo.

The disease is liable to occur when a field cropped persistently to upland crops is turned over to paddy. With the lapse of years the disease disappears. It occurs on any type of soil, from sand to clay. Generally, the incidence of disease is more in soils with low water holding capacity. It occurs less near the inlet of irrigation water than near the outlet. After flooding, Eh of the affected field is higher than the ordinary one persistently cropped to paddy but later Eh goes down. The area affected is small as the practice of change over from upland to paddy and vice versa is restricted. The possible direct cause for the occurrence of disease is the abrupt lowering of Eh with the concurrent formation of toxic substances due to reduction.

The remedial measures that can be adopted are the growing of resistant varieties and throwing the soil in ridges and planting the seedlings on the ridges.

Aogare (Green Withering)

The sudden wilting and dying of plants after the milk stage without any previous symptoms is the chief characteristic of this disease. This disease was prevalent in S.W. Japan in some areas in 1955 when the highest yield was recorded for the whole of Japan. The affected areas generally have sandy or gravelly subsoil with light top soil. It is rarely found in soils of heavy texture. There is also some relationship for its occurrence to greater diurnal fluctuations in temperature and low night tempera-

tures below 12-13°C with dry winds prevalent during the period.

The remedial measures suggested are 1) irrigation should be continued after the milk stage, 2) too much nitrogen and too little potash should be avoided and 3) care should be taken not to induce root rot.

Hideri-Aodachi (Drought Green Standing)

Vegetative growth of the plant is vigorous. Leaves do not wilt. Panicles are large or normal. Date of heading is scarcely delayed. Heads emerge out normally. There is scarcely any discolouration in glumes, but many kinds of deformed flowers appear in the panicles. Flowers with beak-like lemma occur most frequently, flowers with many

glumes, degenerated palea as well as flowers with palea and lemma of the same size are characteristic symptoms. The disease is rare and occurs in years of severe drought and has no relationship with soil texture. High content of decomposable organic matter and free iron in soils are related to its occurrence. Also shortage of water at the time of reduction division may be a direct cause. The occurrence of the disease can be prevented by adopting the following measures:— 1) making ridges over the field to oxidize and decrease the organic matter content, 2) saving the water during vegetative stage and applying it after the initiation of panicle primordia and 3) avoiding too much application of nitrogen and top-dressing of nitrogen.

MALAYA

Penyakit Merah

Two distinct types of symptoms have been reported for this disease. In one, small dark brown spots appear near the tips of the older leaves. These spots increase in size until they coalesce and the whole leaf eventually turns dark brown and dies. In the second type, the tips of the older leaves

turn yellow, and this colour progresses down the lamina leaving the mid-rib green. At this stage the symptom resembles that of phosphorus deficiency. Later, the yellow areas and the mid-rib turn orange in colour and after half of the leaf is involved, the leaf usually dies and the colour of the dead leaf is light brown. Both types are occasionally present in the same field.

PAKISTAN

Pansuk

The early symptoms are that the outer leaves turn reddish-yellow from the tip downwards. The symptoms are so marked that even a single plant with a single affected leaf can be identified. The inner leaves get affected in a course of week or so if no proper measures are

taken to check the disease. Once the disease appears, within about a week or a large number of plants show the same symptoms. The affected plants can further be distinguished by the following characteristics:— 1) death of outer leaves and some of the tillers, 2) the low proportion of ear bearing tillers to total tillers, 3)

stunted growth and short panicles, 4) sterility and low yield of grain and 5) susceptibility to fungoid diseases. The disease is found both in transplanted *aman* and *boro* varieties. The scented varieties appear to be free while non-scented varieties are affected in varying degrees. The extent of the area affected is very small except during the year 1953.

The plants are affected after a period of one month after transplanting and stagnant water without proper drainage is favourable for the disease. Drying of the field and application of fertilizers such as ammonium sulphate or even cow dung may sometimes help in partial recovery of the affected plants.

TAIWAN (China)

Chin-Sng-tsan

The symptoms are similar to those of *helminthosporium* disease. Roots are small in volume with fewer branching rootlets. The disease symptoms begin to appear one month after transplanting. In some cases, affected plants die at this stage. It is more prevalent during first crop season than in the second crop.

Horai (Japonica) varieties are more susceptible than the native Indica varieties. The area affected is small and is confined to only 200 hectares. High water table, recent slate alluvium, loamy texture ranging from gravelly sandy loam to silt loam, fairly high organic matter content — all these soil and water conditions are favourable for the disease. The damage is less in farms with gravelly substratum underneath.

The disease is liable to appear in years of excessive rainfall and in years

of low rainfall, the same fields affected in years of heavy rains may be free and yield well. Sudden showers after a spell of fine hot weather causes serious damage. Application of N, P and K fertilizers has no effect though ashes of straw appear to be somewhat effective indicating the probable effect of silica or K. The cause may be due to the presence of excessive soluble iron and manganese and perhaps due also to lack of K_2O .

Remedial measures suggested are (1) the draining of field after 1st weeding, (2) changing to dry land cultivation usually half to one year by raising sweet potatoes or vegetables. The favourable effect persists only up to the following rice crop and does not extend to the next succeeding rice crop and (3) incorporation of high land soils though labour consuming.

USA

Straight Head

Panicles on affected plants remain upright at maturity because of the weight of the few grains formed being so low to bend the panicle over in a normal manner. The hulls are distorted into

a typically crescent or "parrot beak" form, and either the palea or lemma, or both may be lacking. The pistil and stamens of affected flowers are also generally absent. Distorted hulls are too many in the long-grain varieties. In

severe cases the panicles are greatly reduced in size with poor or no emergence from the sheath of the boot. Affected plants remain vegetative with a dark green colour and frequently produce tillers from the lower nodes.

Affected plants of varieties, such as Colusa (C.I. 1600) in the short-grain group frequently show excessive sterility with little or moderate glume distortion. Such varieties must be considered as susceptible to straighthead since they produce only few grains. Formerly, glume distortion was erroneously regarded

as the primary symptom or criterion for straighthead.

The disease is related to poor drainage conditions and high organic matter content, and usually occur on silty soils and not on clay soils. It is also indirectly related to excessive rainfall at the time when the fields require drainage. The extent of the area affected by this disease is about 5,000 hectares. The disease can be controlled by drainage and drying of the soil just before the heading stage and also by growing resistant varieties.

A SHORT NOTE ON THE TRIAL OF SOME INTRODUCED PADDY VARIETIES AT HIMAYATSAGAR, ANDHRA PRADESH

M.S. Pawar¹, V.V.S. Murthy² and P. Narahari³

Introduction

Introduction of improved varieties of crops into a particular region from outside, can sometimes be effective, economic and time saving. An outstanding example in rice is the introduction of Chinese varieties in Kashmir Valley, India. A large proportion of the local varieties has now been replaced by a Chinese variety.

Rice is the most important food crop of Andhra Pradesh. The annual estimated area and production are about 3 million hectares and 3.4 million tons respectively. From the time paddy research was initiated in this State about fifty years ago, a total of seventy-eight improved varieties ranging in maturity from 95 to 220 days from seed to seed have so far been evolved. These varieties satisfy to a certain extent, the needs of the farmer, the trader, the miller and the consumer.

At Himayatsagar, previously in Hyderabad State, now included in Andhra State, work on paddy was initiated on a very modest scale in the year 1928 and it was not till 1950 that a full fledged section for paddy research was organized. Since then, a concerted effort was made to collect as many improved varieties as possible from within and outside the country and test them for their general suitability to the soil, climate and market conditions of the region.

A total of 680 improved varieties from all the Indian States and 266 from 19 important rice growing countries of the world were collected. These were critically studied at Himayatsagar, Rudroor, Dindi and Dhariesugur Research Stations (the last mentioned is now in Mysore State) for their suitability to the Telangana region. The list of the number of varieties received from the different countries outside India is given below:

1. Australia	— 17
2. Burma	— 8
3. Ceylon	— 18
4. China	— 28
5. Egypt	— 11
6. French Sudan	— 12
7. Indo-China	— 3
8. Indonesia	— 16
9. Iran	— 8
10. Iraq	— 2
11. Italy	— 19
12. Japan	— 22
13. Malaya	— 2
14. Pakistan	— 16
15. Philippines	— 6
16. Sierra Leone	— 6
17. Thailand	— 12
18. U.S.A.	— 57
19. U.S.S.R.	— 3
Total:	<u>266</u>

While the results of trials of all the above varieties are reviewed in general,

1. Deputy Agricultural Commissioner to the Government of India, Indian Council of Agricultural Research, New Delhi, India.
2. Rice Research Assistant, Agricultural Research Institute, Himayatsagar.
3. Rice Research Assistant, Agricultural Research Institute, Himayatsagar.

more details regarding the Indonesian varieties are given in this note.

The 'Japonica' types from Australia, Egypt, French Sudan, Italy, Iran, Iraq, Japan, U.S.A., U.S.S.R. mature too early under the soil and climatic conditions prevailing in Andhra Pradesh. The growth is stunted and very few tillers are produced and the yields are poor.

Among the 'Indica' types, a few from Thailand, Ceylon, China and Indonesia showed promise. Other 'Indica' types of Iran, Iraq and U.S.A., though satisfactory in respect of grain quality are low in yields and are, therefore, unsuitable. Varieties from Thailand, are fairly high yielding but too late in maturity (over 7 months from seed to seed) and are therefore of no commercial importance. Although the Ceylonese varieties are high in yield, they are not acceptable in the market, because of the red pericarp colour of the kernel. Among the Chinese varieties CH. 45 (on account of its earliness and high yield) has already been released and is spreading.

The majority of the Indonesian paddy varieties belong either to the 'Tjereh' or the 'Bulu' groups. The 'Tjereh' varieties are characterized by the absence of awns on the outer glumes and are moderately hardy. They possess medium to fine grain. The 'Bulus' are usually bearded and the grains are coarse and round.

Sixteen varieties from Indonesia have been under trial since 1953. Detailed observations regarding characters like habit of the plant, flowering duration and maturity period, length of panicle, grain type, grain shedding and non-

lodging straw were made for all the varieties.

Most of the varieties possess compact habit. All the varieties flower in 130-145 days and mature in 160-175 days (from seed to seed). They are, therefore, suitable for the Abi* season only. Most of the Indonesian varieties are earlier than the control by one week to ten days.

The varieties have invariably long compact and drooping panicles compared to the local Indica varieties. In Indonesia, paddy fields are situated far away from the villages. Farmers, therefore, prefer to cut only the panicles and cart them as such to the threshing yard in the village. Breeding varieties for long panicles, therefore, fits in with the harvesting practices of that country.

Among the bulu varieties, *Sukanandi*, Baok, Gendjah Beton, Gendjah Ratji and Brondol Putih were outstanding for their non-shedding of grain, and in this group of varieties, Kentjana was the only highly shedding one. Most of these varieties are also non-lodging.

Yield data

All the improved varieties that were imported from Indonesia were tried in replicated tests with a net plot size of 1/1936 acre during the Abi seasons of the years 1953-54, 1954-55, 1955-56 and 1/1021 acre in Abi 1957-58. Nurseries were raised in the month of June each year and transplanting was done in July. The seedlings were planted 8" to 8" apart with one seedling per hill, and plots manured at the rate of 60 N+30 P₂O₅ per acre. Details of results are given in Table No. 1.

*1st crop season extending from June-July to November-December,

The following conclusions are based on the results of statistical analysis of the data.

- a) Varietal differences are present in all the four seasons
- b) On combined analysis it is seen that the differences between varieties over all the seasons remained significant while the interaction between seasons and varieties is not significant.
- c) The difference in yield between the first ten varieties viz., HR. 38, Kentjana, Salak, Bengawan, Tjina, No. 2904. Fadjar, Peta, No. 2813 and Tjahaja are not significant.
- d) HR. 35, MTU. 19 and RDR. 4 which were included as controls in one or more seasons did not give significantly better yields than any of the above 1st ten varieties. (These controls were not included in the combined analysis as they were not tried in all the seasons).

In Indonesia, Tjina matures in 170 days while at Himayatsagar the same variety requires 176 days. The variety is profuse in tillering and is fairly resistant to lodging but grain shatters

easily at both the places. The varieties Bengawan and Salak are hybrids of Tjina of Indonesia and Lati-sail of Assam, India. Bengawan, incidentally occupies an area of 2,000,000 acres in Indonesia, which is quite a record for a single variety.

Summary

The Japanese method of paddy cultivation which among other items, includes the use of heavy doses of fertilizers is gaining ground in this State. Therefore, the need for non-lodging, non-shattering and high yielding varieties is keenly felt by the farmers.

A few of the promising Indonesian varieties such as Kentjana, Salak, Bengawan, Tjina and No. 2904 could be recommended for cultivation in view of their high yields, comparative earliness, compact habit, rather stiff straw, long panicles and white rice. The other varieties, however, could be utilized for further breeding.

Acknowledgments

The authors are grateful to Mr. H. Siregar, Agronomist, Main Agricultural Experiment Station, Bogor, Indonesia for kindly supplying seed of the above varieties.

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TABLE 1

Showing the performance of Indonesian varieties at Himayatsagar.

Sl. No.	varieties with bar notation	Av. yield per acre in pounds	Maturation period in days from seed to seed	Height in Cm	No. of ears	Panicle length in Cm	Remarks
I.							
1.	HR. 38	5222	177	140.5	7.2	25.7	
II.							
2.	Kentjana	4868	167	147.3	6.8	27.3	
3.	Salak	4834	168	142.9	9.3	26.9	
4.	Bengawan	4825	168	142.5	10.2	29.3	
5.	Tjina	4768	176	154.1	8.9	27.2	
6.	No. 2904	4726	171	148.8	9.6	26.7	
7.	Fadjar	4688	172	149.7	9.9	26.9	
8.	Peta	4682	164	134.4	8.5	26.2	
9.	No. 2813	4595	168	147.2	9.3	26.7	
10.	Tjahaja	4580	179	140.7	8.4	28.8	
III.							
11.	Peloppor	4211	173	135.0	8.7	27.3	
12.	Mas	4037	161	128.9	10.2	25.4	
IV.							
13.	Baok	3297	171	149.0	5.4	29.5	Non-shedding
14.	Brondolputih	3206	171	145.3	6.9	28.3	— do —
15.	Gendja Ratji	2969	167	137.1	8.0	24.5	— do —
16.	„ Beton	2952	163	140.6	5.4	27.0	— do —
17.	Sukanandi	2849	163	133.8	5.7	27.3	— do —
18.	S.E.M.	300.0	—	—	—	—	—
19.	C.D.	866.8	—	—	—	—	—

N.B.: The above data regarding maturation period, height, tillers and panicle length is an average of five Abi seasons of the years 1953-54 to 1957-58.

INTRODUCING THE INTERNATIONAL RICE RESEARCH INSTITUTE

P.C. Ma¹

The International Rice Research Institute (IRRI) is organized as an autonomous, non-stock, philanthropic, non-profit corporation under the laws of the Republic of the Philippines on April 14, 1960 in Manila. It is established principally through the support of the Ford and the Rockefeller Foundations of the United States of America in co-operation with the Government of the Philippines although financial support will also be sought from other sources.

The objectives of the Institute are as follows:

- 1) To conduct basic research on the rice plant, on all phases of rice production, management, distribution and utilization with a view to attaining nutritive and economic advantage or benefit for the people of Asia and other major rice-growing areas through improvement in quality and quantity of rice;
- 2) To publish and disseminate research findings and recommendations of the Institute;
- 3) To distribute improved plant materials to regional and international research centers where they might be of significant value or use in breeding or improvement programs;
- 4) To develop and educate promising young scientists, primarily from South and Southeast Asia along lines connected with or

related to rice production, distribution and utilization, through a resident training program under the guidance of well-trained and distinguished scientists;

- 5) To establish, maintain and operate an information center and library which will provide interested scientists and scholars everywhere with a collection of the world's literature on rice; and
- 6) To organize or hold periodic conferences, forums and seminars, whether international, regional, local or otherwise for the purpose of discussing current problems.

The Institute is administered by a Board Trustees composed of ten members. The Board of Trustees has the following powers and duties:

- 1) To act as the policy-making body of the Institute and to lay down or approve its program of activities;
- 2) To approve the budget and review the financial condition of the Institute;
- 3) To review and evaluate the progress reports of the Institute as may be submitted by the Directors;
- 4) To exercise corporate powers in the conduct of the business and control of properties owned or held by the Institute;

¹ Dean, College of Agriculture, National Taiwan University, Taipei, Taiwan, China.

- 5) To delegate any or some of its powers to the Executive Committee to be appointed by the Board from the members of the Board; and
- 6) To exercise such other powers and to do such acts as may be conducive to the promotion of the purpose or objectives for which the Institute was established.

The ten trustees serving at present are:

- 1) Dr. J.G. Harrar, Vice-President of the Rockefeller Foundation of New York.
- 2) Dr. R.F. Chandler, Jr., Associate Director for Agricultural Sciences of the Rockefeller Foundation.
- 3) Dr. F.F. Hill, Vice-President of the Ford Foundation of New York.
- 4) Mr. J. de G. Rodriguez, Secretary of Agriculture and Natural Resources, Government of Republic of the Philippines.
- 5) Mr. V.G. Sinco, President of the University of the Philippines.
- 6) Dr. P. Garcia, Chairman of the National Science and Development Board of the Philippines.
- 7) Mr. K.R. Damle, Secretary, Ministry of Food and Agriculture Government of India.
- 8) Dr. H. Kihara, Director of the National Institute of Genetics, Mishima, Japan.
- 9) Prince M.C. Chakrabandhu, Director of the Rice Department, Ministry of Agriculture, Government of Thailand.
- 10) Dr. P.C. Ma, Dean, College of Agriculture, National Taiwan University, China.

The Board of Trustees held its first meeting on April 13-14, 1960 in Manila, Philippines and the following resolutions were adopted:—

- 1) Dr. Harrar was elected the Chairman, and Dr. L.S. Wortman, a member of the Rockefeller Foundation, the Secretary-Treasurer of the Board.

- 2) An Executive Committee was appointed, composed of the following members:

Dr. Harrar — Chairman
 Dr. Hill
 Dr. Garcia
 Mr. Damle
 Dr. Chandler

It was understood that the Executive Committee would also look after the building and construction program of the Institute.

- 3) A Program Committee was appointed, made up of the following members:

Dr. Kihara — Chairman
 Dr. Ma
 Mr. Rodriguez
 Prince Chakrabandhu

- 4) The appointment of a Finance Committee, including:

Mr. Sinco — Chairman
 Dr. Harrar
 Mr. Damle

- 5) Ratification of the nominations of Dr. Chandler as the Director, and of Dr. Wortman as the Assistant Director, of the Institute.

Dr. Chandler is a soil scientist and was the first forest-soil professor of Cornell University.

Dr. Wortman is a plant breeder and he was previously with the Hawaiian Pineapple Research Institute.

6) Adoption and approval of the Bylaws of the Institute.

The Institute is to be located at Los Banos on a piece of land of the College of Agriculture, University of the Philippines. The land is leased for an initial term of twenty-five years at an annual rental of one peso subject to renewal. Additional land for experimental purposes would be purchased with funds (US \$250,000) provided by the Ford Foundation. A total of 81.6 ha. of land shall be acquired, 37.6 ha. from the College and 44 ha. to be purchased from private sources. On March 18, 1960, the Trustees of the Ford Foundation authorized an additional appropriation of US \$6,900,000 for constructing and equipping the Institute, so as to assure the Institute of a first-class physical plant. The Rockefeller Foundation already appropriated the sum of US \$185,000 to meet the operating costs of the Institute prior to its inauguration in the Philippines and indicated the willingness to receive annual requests for funds for operating the Institute for an indefinite period of time.

It is anticipated that the Institute may be staffed with fifteen senior research scientists. Each scientist may

have one to several junior scientists working with him and, of course trainees in varying numbers, depending upon the field of speciality. Specialized technicians, also, will be needed in the laboratories and offices. Visiting scientists may be invited for short periods of time to give guidance in their specialized fields. It is expected that the senior research scientists will come from various countries and will represent some of the most competent specialists available. It is the goal of the Institute to conduct research of the highest quality, which will compare favorably with the best in the world. This can only be done by giving the most careful attention to the selection of the staff and by expecting superior performance from each person, regardless of his rank in the organization.

It is expected that building construction can be started by October, 1960, and completed by April, 1962. The major staff members will be recruited in 1961, and many of them should be in residence three to six months before the scientific buildings are completed so that they can take part in planning the arrangement of the laboratories and in procuring the equipment. However, an agricultural engineer may join the staff in 1960. His initial assignment will be to lay out an irrigation and drainage system for the Institute's experimental fields. An agronomist, also, may be needed immediately to assist in getting all land in condition for experimental work.

With the facilities made possible by the recent grant from the Ford Foundation and with resources to attract a truly superior scientific staff, all concerned can look forward to the creation of an Institute that will be clearly recognized as the world's foremost research center on rice, the authoritative source of all important information on the crop, and a place where young scientists may receive superior training in any aspect of rice research.

The organization-pattern and the objectives of the Institute are truly unique. I am enthusiastic about its future and am honored to serve in its first Board of Trustees. In Taiwan, we believe that in the near future we must lay the cornerstone for a more advanced rice technology to place our rice production on a higher level. More basic studies are therefore needed. We look forward to the Institute as a guiding force in shaping such programs.

